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OPTIMAL DESIGN OF CATHODIC PROTECTION SYSTEMS FOR OFFSHORE WIND TURBINE SUPPORT STRUCTURES

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Cathodic protection (CP) can be defined as preventing a metal surface to corrode by making that surface the cathode of an electrochemical cell. Cathodic protection is one of the common methods for corrosion protection of offshore wind turbine support structures. Improper corrosion protection of offshore wind turbine support structures can lead to significant lifetime degradation of these structures. One could say that the corrosion uncertainty is one of the most influential parameters on residual fatigue lifetime of monopile support structures [1]. Furthermore, if the corrosion protection system must be repaired, the associated cost can be much higher than the initial installation cost of the corrosion protection system [2]. Hence an efficient and cost-effective design of a CP system is of crucial importance. Current manual design of CP systems using standards can be time-consuming as well as lead to a costly CP design. Moreover, the positions of the anodes on the support structure, as an influential parameter on the performance of the CP system, are not determined in the design standards.

The current study addresses the optimal design process of a CP system for offshore wind turbine support structures. The optimization process is carried out in two steps. First, the mass/cost of the CP system is minimized by formulating an optimization problem with number and dimensions of the anodes as design variables, and the criteria in the design standard as non-linear design constraints. Second, the positions of the anodes on the structure are determined in such a way that the protective potential criteria on the structure are satisfied. The non-linear optimization problem is modelled in MATLAB and the protective potential on the structure is calculated using boundary element method (BEM). Using BEM for calculating the protective potential instead of finite element method reduces the computational cost, considerably. The obtained results show the efficiency of the proposed optimization procedure for reducing the cost of CP systems as well as improving their performance.

REFERENCES

[1] L. Ziegler and M. Muskulus, Fatigue reassessment for lifetime extension of offshore wind monopile substructures, J. Phys. Conf. Ser., 753 92010, 2016.

[2] A. Momber, Corrosion and corrosion protection of support structures for offshore wind energy devices (OWEA), Mater. Corros., 62(5), pp. 391–404 , 2011.